Home Bank & Trust
Wichita, Sedgwick County, Kansas
02/23/05

Home Bank & Trust is a 2.71 acre commercial development at the northwest corner of 13th Street North and Greenwich Road within the city limits of Wichita in Sedgwick County, Kansas. The two lot development consists mostly of asphalt parking and impervious rooftops with small areas for landscaping. This report contains a drawing of the drainage plan, supporting calculations and data for the Home Bank & Trust Drainage Plan.

Hydrology

The proposed plat lies in the SE 1/4, SE 1/4, Section 9, T27S, R2E. The soil on-site is comprised of Irwin silty clay loam, which is classified in hydrologic group D. The land is currently used for agricultural purposes and has short grass and bare ground throughout. The site is bordered to the north and west by agricultural land, to the south by 13th Street North, and to the east by Greenwich Road. A small detention pond lies in the center of the site, but will be removed with proposed improvements. Approximately two acres from the west (offsite) drains onto this development, which generally flows to the east throughout. Storm sewer does exist near this development along 13th Street North and Greenwich Road and was designed to handle existing flows from this site.

The Rational Method was used to calculate runoff quantities. Runoff coefficients were estimated based on tables presented in the Design Aids section of this report using fully developed conditions. Time of concentration was based on slope, flow velocity and length of flow through each basin and was not allowed to be less than 15 minutes. The HEC-1 computer program was used to route the runoff through the site and determine the pre- and post-development conditions leaving the development.

The proposed runoff rate of 19 cfs is relatively the same as the existing runoff rate of 17 cfs during the 100-Yr storm event. The effects of the small existing pond were ignored for this analysis. Note that curb-high storage will be provided within the parking lots on this site before the runoff outfalls to 13th Street North and Greenwich Road.

The analysis was made based on the available site data which includes the following: 1" = 30' topographic map with 1' contours of the site, a Sedgwick County Soil Survey Map and noted references.

Design Aids

This section includes material used to assist in designing the drainage system. A 1" = 30' scale Drainage Plan map is enclosed in the pocket.

References

Design of Urban Highway Drainage – The State of the Art, by Reitz & Jens, Inc., April 1980.

Drainage of Highway Pavements, Hydraulic Engineering Circular #12, by Tye Engineering, Inc., March 1984.

Interim Drainage and Storm Sewer Policy for Design Criteria and Documentation, City of Wichita, Kansas, 1985.

Soil Survey of Sedgwick County, Kansas, US Department of Agriculture, Soil Conservation Service, 1979.

Project: **Home Bank and Trust**
Date: 2/23/2005
Prep. By: BLB

Manual Input

Offsite

Total Area 1.72 Acres

Soil Group	**A** (% of Total Area)	**B** (% of Total Area)	**C** (% of Total Area)	**D** (% of Total Area)	**Total**
	0%	0%	0%	100%	100%
Acres	0.00	0.00	0.00	1.72	1.72

Land Use	**Commercial** (% of Total Area)	**Industrial** (% of Total Area)	**Multi-Family** (% of Total Area)	**Public** (% of Total Area)	**Single Family** (% of Total Area)	**Vacant/Agriculture** (% of Total Area)
Existing	0%	0%	0%	0%	0%	100%
Acres	0.00	0.00	0.00	0.00	0.00	1.72

	Existing	
Length of Flow	250	ft
Slope	1.20	%
Waterflow Desc	bare / short grass	
Avg Velocity	0.30	ft/sec
Tc	0.23	hours

15 min <= Tc <= 24 hrs

Runoff Coefficients * Used Soil Group D To Be Conservative

Return Period (Years)	Commercial	Industrial	Multi-Family	Public	Single Family	Vacant/Agriculture
2	0.68	0.68	0.70	0.49	0.50	0.54
5	0.69	0.69	0.73	0.51	0.54	0.56
10	0.73	0.73	0.79	0.56	0.62	0.61
25	0.75	0.75	0.81	0.59	0.66	0.64
50	0.77	0.77	0.83	0.62	0.70	0.67
100	0.80	0.80	0.86	0.66	0.76	0.70

Existing Conditions

Return Period (Years)	Runoff Coefficient *	Rainfall Intensity (in/hr)	Area (Acres)	Runoff (cfs)
2	0.54	3.83	1.72	3.56
5	0.56	4.56	1.72	4.39
10	0.61	5.22	1.72	5.48
25	0.64	6.06	1.72	6.67
50	0.67	6.78	1.72	7.81
100	0.70	7.37	1.72	8.87

Project: **Home Bank and Trust**
Date: 2/23/2005
Prep. By: BLB

Manual Input

Site

Total Area 2.71 Acres

Soil Group	**A** (% of Total Area)	**B** (% of Total Area)	**C** (% of Total Area)	**D** (% of Total Area)	**Total**
	0%	0%	0%	100%	100%
Acres	0.00	0.00	0.00	2.71	2.71

Land Use	**Commercial** (% of Total Area)	**Industrial** (% of Total Area)	**Multi-Family** (% of Total Area)	**Public** (% of Total Area)	**Single Family** (% of Total Area)	**Vacant/Agriculture** (% of Total Area)
Existing	0%	0%	0%	0%	0%	100%
Acres	0.00	0.00	0.00	0.00	0.00	2.71

	Existing	
Length of Flow	658	ft
Slope	1.52	%
Waterflow Desc	bare / short grass	
Avg Velocity	0.40	ft/sec
Tc	0.46	hours

15 min <= Tc <= 24 hrs

Runoff Coefficients * Used Soil Group D To Be Conservative

Return Period (Years)	Commercial	Industrial	Multi-Family	Public	Single Family	Vacant/Agriculture
2	0.68	0.68	0.70	0.49	0.50	0.54
5	0.69	0.69	0.73	0.51	0.54	0.56
10	0.73	0.73	0.79	0.56	0.62	0.61
25	0.75	0.75	0.81	0.59	0.66	0.64
50	0.77	0.77	0.83	0.62	0.70	0.67
100	0.80	0.80	0.86	0.66	0.76	0.70

Existing Conditions

Return Period (Years)	Runoff Coefficient *	Rainfall Intensity (in/hr)	Area (Acres)	Runoff (cfs)
2	0.54	2.78	2.71	4.07
5	0.56	3.37	2.71	5.11
10	0.61	3.90	2.71	6.45
25	0.64	4.55	2.71	7.89
50	0.67	5.12	2.71	9.30
100	0.70	5.59	2.71	10.60

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*             JUN   1998                *
*           VERSION 4.1                 *
*                                       *
*  RUN DATE   23FEB05  TIME  10:42:11   *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```

```
X     X  XXXXXXX   XXXXX          X
X     X  X        X     X        XX
X     X  X        X              X
XXXXXXX  XXXX     X       XXXXX  X
X     X  X        X              X
X     X  X        X     X        X
X     X  XXXXXXX   XXXXX         XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM


```
         LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

           1           ID      HOME BANK & TRUST
           2           ID      EXISTING CONDITIONS
           3           ID    1,2,5,10,25,50 & 100 YR-24 HR Storm Events
           4           ID      BY BLB    DATE 02-23-05
*** LIST ***
*** FREE ***
                       *DIAGRAM
           5           IT      15 01JAN05    1200       0 02JAN05    2000
           6           IN      15 01JAN05    1200
           7           IO       0       5
           8           JR    PREC     3.0     3.5     4.5     5.3     6.1     7.0     7.8
                       *
                       *
                       *

           9           KK    OFFS
          10           KO       5
          11           BA   0.003
          12           PB    1.00
          13           PC   0.000   0.003   0.006   0.008   0.011   0.014   0.017   0.019   0.022   0.025
          14           PC   0.029   0.032   0.035   0.038   0.042   0.045   0.048   0.052   0.056   0.060
          15           PC   0.064   0.068   0.072   0.076   0.080   0.085   0.090   0.095   0.100   0.105
```

```
   16          PC   0.110   0.115   0.120   0.127   0.134   0.140   0.147   0.155   0.163   0.172
   17          PC   0.181   0.193   0.204   0.220   0.235   0.259   0.283   0.387   0.663   0.699
   18          PC   0.735   0.754   0.772   0.786   0.799   0.810   0.820   0.828   0.835   0.843
   19          PC   0.850   0.858   0.865   0.873   0.880   0.885   0.889   0.894   0.898   0.903
   20          PC   0.907   0.912   0.916   0.921   0.925   0.929   0.934   0.938   0.943   0.947
   21          PC   0.952   0.955   0.958   0.961   0.964   0.967   0.970   0.973   0.976   0.979
   22          PC   0.982   0.985   0.988   0.991   0.994   0.997   1.000
   23          LS       0      75      10
   24          UD   0.160
               *
               *

   25          KK    RTE1
   26          KO       5
   27          RT       0       0       1
               *
               *

   28          KK    SITE
   29          KO       5
   30          BA   0.004
   31          PB    1.00
   32          PC   0.000   0.003   0.006   0.008   0.011   0.014   0.017   0.019   0.022   0.025
   33          PC   0.029   0.032   0.035   0.038   0.042   0.045   0.048   0.052   0.056   0.060
   34          PC   0.064   0.068   0.072   0.076   0.080   0.085   0.090   0.095   0.100   0.105
   35          PC   0.110   0.115   0.120   0.127   0.134   0.140   0.147   0.155   0.163   0.172
   36          PC   0.181   0.193   0.204   0.220   0.235   0.259   0.283   0.387   0.663   0.699
   37          PC   0.735   0.754   0.772   0.786   0.799   0.810   0.820   0.828   0.835   0.843
   38          PC   0.850   0.858   0.865   0.873   0.880   0.885   0.889   0.894   0.898   0.903
   39          PC   0.907   0.912   0.916   0.921   0.925   0.929   0.934   0.938   0.943   0.947
   40          PC   0.952   0.955   0.958   0.961   0.964   0.967   0.970   0.973   0.976   0.979
   41          PC   0.982   0.985   0.988   0.991   0.994   0.997   1.000
   42          LS       0      75      10
```



```
  LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

   43          UD   0.200
               *
               *

   44          KK   TOTAL
   45          KO       5
   46          HC       2       0
               *
               *
               *
               *
   47          ZZ
```

1

SCHEMATIC DIAGRAM OF STREAM NETWORK

```
 INPUT
  LINE      (V) ROUTING          (---->) DIVERSION OR PUMP FLOW

   IO.      (.) CONNECTOR        (<----) RETURN OF DIVERTED OR PUMPED FLOW

    9        OFFS
               V
               V
   25        RTE1
```

```
                .
                .
   28           .        SITE
                .          .
                .          .
   44       TOTAL.....
```

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*              JUN   1998              *
*           VERSION 4.1                *
*                                      *
*  RUN DATE   23FEB05  TIME  10:42:11  *
*                                      *
****************************************
```

```
****************************************
*                                      *
*    U.S. ARMY CORPS OF ENGINEERS      *
*    HYDROLOGIC ENGINEERING CENTER     *
*         609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616        *
*           (916) 756-1104             *
*                                      *
****************************************
```

HOME BANK & TRUST
EXISTING CONDITIONS
1,2,5,10,25,50 & 100 YR-24 HR Storm Events
BY BLB DATE 02-23-05

```
7 IO        OUTPUT CONTROL VARIABLES
                IPRNT        0  PRINT CONTROL
                IPLOT        5  PLOT CONTROL
                QSCAL        0.  HYDROGRAPH PLOT SCALE

  IT        HYDROGRAPH TIME DATA
                NMIN        15  MINUTES IN COMPUTATION INTERVAL
                IDATE     1JAN 5  STARTING DATE
                ITIME       1200  STARTING TIME
                  NQ         129  NUMBER OF HYDROGRAPH ORDINATES
              NDDATE     2JAN 5  ENDING DATE
              NDTIME       2000  ENDING TIME
              ICENT          19  CENTURY MARK

           COMPUTATION INTERVAL      .25 HOURS
               TOTAL TIME BASE    32.00 HOURS

    ENGLISH UNITS
        DRAINAGE AREA         SQUARE MILES
        PRECIPITATION DEPTH   INCHES
        LENGTH, ELEVATION     FEET
        FLOW                  CUBIC FEET PER SECOND
        STORAGE VOLUME        ACRE-FEET
        SURFACE AREA          ACRES
        TEMPERATURE           DEGREES FAHRENHEIT

  JP        MULTI-PLAN OPTION
              NPLAN          1  NUMBER OF PLANS

  JR        MULTI-RATIO OPTION
            RATIOS OF PRECIPITATION
            3.00     3.50     4.50     5.30     6.10     7.00     7.80
```

*** ***

```
          **************
          *            *
 9 KK     *      OFFS  *
          *            *
          **************

 10 KO          OUTPUT CONTROL VARIABLES
                     IPRNT          5  PRINT CONTROL
                     IPLOT          5  PLOT CONTROL
                     QSCAL         0.  HYDROGRAPH PLOT SCALE
```

*** ***

```
          **************
          *            *
 25 KK    *      RTE1  *
          *            *
          **************

 26 KO          OUTPUT CONTROL VARIABLES
                     IPRNT          5  PRINT CONTROL
                     IPLOT          5  PLOT CONTROL
                     QSCAL         0.  HYDROGRAPH PLOT SCALE
```

*** ***

```
          **************
          *            *
 28 KK    *      SITE  *
          *            *
          **************

 29 KO          OUTPUT CONTROL VARIABLES
                     IPRNT          5  PRINT CONTROL
                     IPLOT          5  PLOT CONTROL
                     QSCAL         0.  HYDROGRAPH PLOT SCALE
```

*** ***

```
          **************
          *            *
 44 KK    *     TOTAL  *
          *            *
          **************

 45 KO          OUTPUT CONTROL VARIABLES
```

IPRNT	5	PRINT CONTROL
IPLOT	5	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

					RATIOS APPLIED TO PRECIPITATION						
OPERATION	STATION	AREA	PLAN		RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6	RATIO 7
					3.00	3.50	4.50	5.30	6.10	7.00	7.80
HYDROGRAPH AT											
+	OFFS	.00	1	FLOW	2.	3.	4.	5.	7.	8.	9.
				TIME	12.00	12.00	12.00	12.00	12.00	12.00	12.00
ROUTED TO											
+	RTE1	.00	1	FLOW	2.	3.	4.	5.	7.	8.	9.
				TIME	12.25	12.25	12.25	12.25	12.25	12.25	12.25
HYDROGRAPH AT											
+	SITE	.00	1	FLOW	2.	3.	5.	6.	8.	9.	11.
				TIME	12.00	12.00	12.00	12.00	12.00	12.00	12.00
2 COMBINED AT											
+	TOTAL	.01	1	FLOW	4.	5.	8.	10.	12.	15.	17.
				TIME	12.25	12.25	12.25	12.25	12.25	12.25	12.25

*** NORMAL END OF HEC-1 ***

Project: **Home Bank & Trust**
Date: 2/23/2005
Prep. By: BLB

Manual Input

Site

Total Area 2.71 Acres

Soil Group	**A** (% of Total Area)	**B** (% of Total Area)	**C** (% of Total Area)	**D** (% of Total Area)	**Total**
	0%	0%	0%	100%	100%
Acres	0.00	0.00	0.00	2.71	2.71

Land Use	**Commercial** (% of Total Area)	**Industrial** (% of Total Area)	**Multi-Family** (% of Total Area)	**Public** (% of Total Area)	**Single Family** (% of Total Area)	**Vacant/Agriculture** (% of Total Area)
Future	100%	0%	0%	0%	0%	0%
Acres	2.71	0.00	0.00	0.00	0.00	0.00

	Future	
Length of Flow	658	ft
Slope	1.52	%
Waterflow Desc	pavement	
Avg Velocity	1.00	ft/sec
Tc	0.18	hours

15 min <= Tc <= 24 hrs

Runoff Coefficients * Used Soil Group D To Be Conservative

Return Period (Years)	Commercial	Industrial	Multi-Family	Public	Single Family	Vacant/Agriculture
2	0.68	0.68	0.70	0.49	0.50	0.54
5	0.69	0.69	0.73	0.51	0.54	0.56
10	0.73	0.73	0.79	0.56	0.62	0.61
25	0.75	0.75	0.81	0.59	0.66	0.64
50	0.77	0.77	0.83	0.62	0.70	0.67
100	0.80	0.80	0.86	0.66	0.76	0.70

Future Conditions

Return Period (Years)	Runoff Coefficient *	Rainfall Intensity (in/hr)	Area (Acres)	Runoff (cfs)
2	0.68	3.83	2.71	7.06
5	0.69	4.56	2.71	8.53
10	0.73	5.22	2.71	10.33
25	0.75	6.06	2.71	12.32
50	0.77	6.78	2.71	14.15
100	0.80	7.37	2.71	15.98

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*             JUN   1998                *
*           VERSION 4.1                 *
*                                       *
*  RUN DATE   23FEB05  TIME  08:58:08   *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*         609 SECOND STREET             *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```

```
X     X  XXXXXXX   XXXXX          X
X     X  X        X     X        XX
X     X  X        X              X
XXXXXXX  XXXX     X       XXXXX  X
X     X  X        X              X
X     X  X        X     X        X
X     X  XXXXXXX   XXXXX         XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM


```
         LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

            1          ID      HOME BANK & TRUST
            2          ID      PROPOSED CONDITIONS
            3          ID    1,2,5,10,25,50 & 100 YR-24 HR Storm Events
            4          ID      BY BLB    DATE 02-22-05
*** LIST ***
*** FREE ***
                       *DIAGRAM
            5          IT      15 01JAN05    1200       0 02JAN05    2000
            6          IN      15 01JAN05    1200
            7          IO       0       5
            8          JR    PREC     3.0     3.5     4.5     5.3     6.1     7.0     7.8
                       *
                       *
                       *

            9          KK    OFFS
           10          KO       5
           11          BA   0.003
           12          PB   1.00
           13          PC   0.000   0.003   0.006   0.008   0.011   0.014   0.017   0.019   0.022   0.025
           14          PC   0.029   0.032   0.035   0.038   0.042   0.045   0.048   0.052   0.056   0.060
           15          PC   0.064   0.068   0.072   0.076   0.080   0.085   0.090   0.095   0.100   0.105
```

```
          16          PC   0.110   0.115   0.120   0.127   0.134   0.140   0.147   0.155   0.163   0.172
          17          PC   0.181   0.193   0.204   0.220   0.235   0.259   0.283   0.387   0.663   0.699
          18          PC   0.735   0.754   0.772   0.786   0.799   0.810   0.820   0.828   0.835   0.843
          19          PC   0.850   0.858   0.865   0.873   0.880   0.885   0.889   0.894   0.898   0.903
          20          PC   0.907   0.912   0.916   0.921   0.925   0.929   0.934   0.938   0.943   0.947
          21          PC   0.952   0.955   0.958   0.961   0.964   0.967   0.970   0.973   0.976   0.979
          22          PC   0.982   0.985   0.988   0.991   0.994   0.997   1.000
          23          LS       0      75      10
          24          UD   0.160
                      *
                      *

          25          KK    RTE1
          26          KO       5
          27          RT       0       0       1
                      *
                      *

          28          KK    SITE
          29          KO       5
          30          BA   0.004
          31          PB    1.00
          32          PC   0.000   0.003   0.006   0.008   0.011   0.014   0.017   0.019   0.022   0.025
          33          PC   0.029   0.032   0.035   0.038   0.042   0.045   0.048   0.052   0.056   0.060
          34          PC   0.064   0.068   0.072   0.076   0.080   0.085   0.090   0.095   0.100   0.105
          35          PC   0.110   0.115   0.120   0.127   0.134   0.140   0.147   0.155   0.163   0.172
          36          PC   0.181   0.193   0.204   0.220   0.235   0.259   0.283   0.387   0.663   0.699
          37          PC   0.735   0.754   0.772   0.786   0.799   0.810   0.820   0.828   0.835   0.843
          38          PC   0.850   0.858   0.865   0.873   0.880   0.885   0.889   0.894   0.898   0.903
          39          PC   0.907   0.912   0.916   0.921   0.925   0.929   0.934   0.938   0.943   0.947
          40          PC   0.952   0.955   0.958   0.961   0.964   0.967   0.970   0.973   0.976   0.979
          41          PC   0.982   0.985   0.988   0.991   0.994   0.997   1.000
          42          LS       0      95      10
1                                          HEC-1 INPUT                                          PAGE  2

        LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

          43          UD   0.160
                      *
                      *

          44          KK   TOTAL
          45          KO       5
          46          HC       2       0
                      *
                      *
                      *
                      *
          47          ZZ
1
                  SCHEMATIC DIAGRAM OF STREAM NETWORK
         INPUT
          LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

          NO.       (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

            9        OFFS
                       V
                       V
           25        RTE1
```

```
                .
                .
   28           .        SITE
                .          .
                .          .
   44       TOTAL.............

 (***) RUNOFF ALSO COMPUTED AT THIS LOCATION
1****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*               JUN   1998             *
*            VERSION 4.1               *
*                                      *
*  RUN DATE   23FEB05  TIME  08:58:08  *
*                                      *
****************************************

****************************************
*                                      *
*    U.S. ARMY CORPS OF ENGINEERS      *
*    HYDROLOGIC ENGINEERING CENTER     *
*          609 SECOND STREET           *
*       DAVIS, CALIFORNIA 95616        *
*           (916) 756-1104             *
*                                      *
****************************************

                        HOME BANK & TRUST
                        PROPOSED CONDITIONS
                         1,2,5,10,25,50 & 100 YR-24 HR Storm Events
                        BY BLB    DATE 02-22-05

   7 IO         OUTPUT CONTROL VARIABLES
                      IPRNT          0  PRINT CONTROL
                      IPLOT          5  PLOT CONTROL
                      QSCAL         0.  HYDROGRAPH PLOT SCALE

     IT         HYDROGRAPH TIME DATA
                       NMIN         15  MINUTES IN COMPUTATION INTERVAL
                      IDATE      1JAN 5  STARTING DATE
                      ITIME       1200  STARTING TIME
                         NQ        129  NUMBER OF HYDROGRAPH ORDINATES
                      NDDATE     2JAN 5  ENDING DATE
                      NDTIME       2000  ENDING TIME
                      ICENT          19  CENTURY MARK

                    COMPUTATION INTERVAL      .25 HOURS
                        TOTAL TIME BASE    32.00 HOURS

          ENGLISH UNITS
               DRAINAGE AREA         SQUARE MILES
               PRECIPITATION DEPTH   INCHES
               LENGTH, ELEVATION     FEET
               FLOW                  CUBIC FEET PER SECOND
               STORAGE VOLUME        ACRE-FEET
               SURFACE AREA          ACRES
               TEMPERATURE           DEGREES FAHRENHEIT

     JP         MULTI-PLAN OPTION
                      NPLAN          1  NUMBER OF PLANS

     JR         MULTI-RATIO OPTION
                    RATIOS OF PRECIPITATION
                   3.00      3.50      4.50      5.30      6.10      7.00      7.80
```

*** ***

```
          **************
          *            *
 9 KK     *      OFFS  *
          *            *
          **************

 10 KO          OUTPUT CONTROL VARIABLES
                     IPRNT           5  PRINT CONTROL
                     IPLOT           5  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE
```

*** ***

```
          **************
          *            *
 25 KK    *      RTE1  *
          *            *
          **************

 26 KO          OUTPUT CONTROL VARIABLES
                     IPRNT           5  PRINT CONTROL
                     IPLOT           5  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE
```

*** ***

```
          **************
          *            *
 28 KK    *      SITE  *
          *            *
          **************

 29 KO          OUTPUT CONTROL VARIABLES
                     IPRNT           5  PRINT CONTROL
                     IPLOT           5  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE
```

*** ***

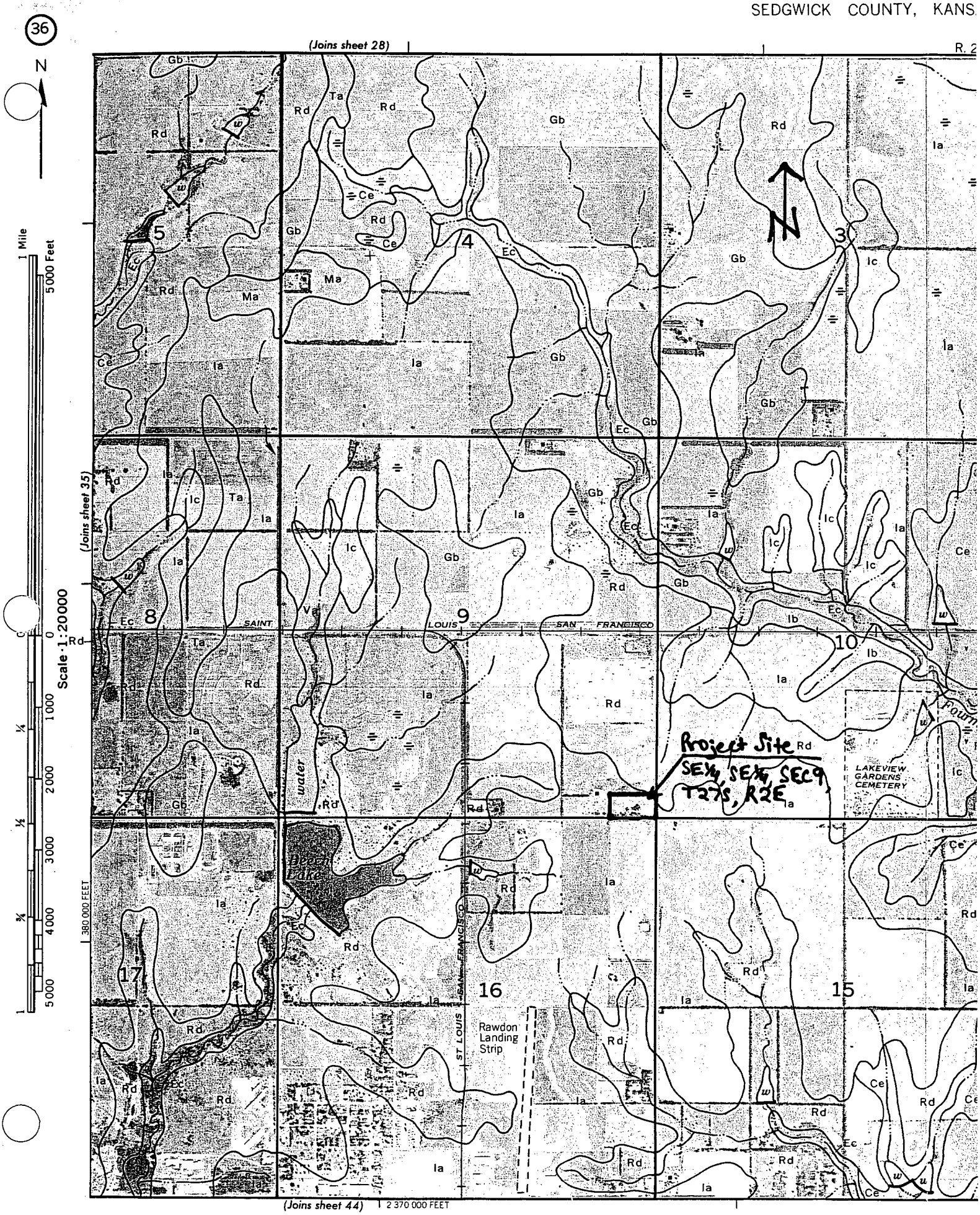
```
          **************
          *            *
 4 KK     *     TOTAL  *
          *            *
          **************

 45 KO          OUTPUT CONTROL VARIABLES
```

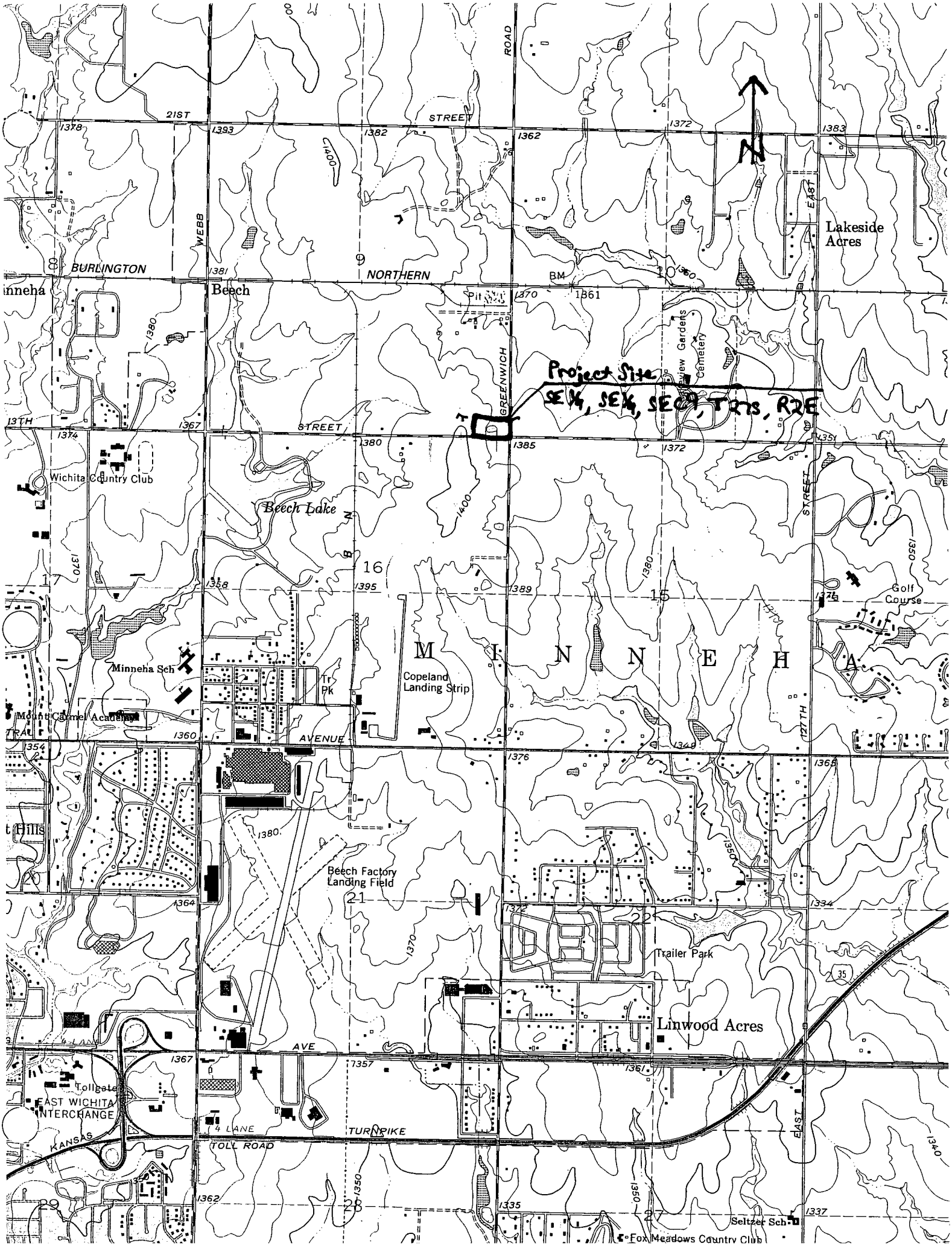
IPRNT	5	PRINT CONTROL
IPLOT	5	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

					RATIOS APPLIED TO PRECIPITATION						
OPERATION	STATION	AREA	PLAN		RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6	RATIO 7
					3.00	3.50	4.50	5.30	6.10	7.00	7.80
HYDROGRAPH AT											
+	OFFS	.00	1	FLOW	2.	3.	4.	5.	7.	8.	9.
				TIME	12.00	12.00	12.00	12.00	12.00	12.00	12.00
ROUTED TO											
+	RTE1	.00	1	FLOW	2.	3.	4.	5.	7.	8.	9.
				TIME	12.25	12.25	12.25	12.25	12.25	12.25	12.25
HYDROGRAPH AT											
+	SITE	.00	1	FLOW	6.	7.	9.	11.	13.	15.	16.
				TIME	12.00	12.00	12.00	12.00	12.00	12.00	12.00
2 COMBINED AT											
+	TOTAL	.01	1	FLOW	6.	8.	10.	12.	15.	17.	19.
				TIME	12.00	12.00	12.00	12.00	12.00	12.00	12.00

*** NORMAL END OF HEC-1 ***


36
(Joins sheet 28)
R. 2
N
1 Mile
5000 Feet
Scale 1:20000
(Joins sheet 35)
SAINT LOUIS
SAN FRANCISCO
ST LOUIS
SAN FRANCISCO
Project Site
SE¼, SE¼, SEC 9
T27S, R2E
LAKEVIEW GARDENS CEMETERY
Deer Lake
Rawdon Landing Strip
water
5
4
3
8
9
10
17
16
15
Gb
Rd
Ta
Ce
Ec
Ma
Ia
Ic
Ib
Va
w
(Joins sheet 44)
2 370 000 FEET
380 000 FEET


Project Site
SE¼, SE¼, SEC 7, T27S, R2E
21ST STREET
WEBB ROAD
GREENWICH ROAD
EAST
13TH STREET
127TH STREET
Lakeside Acres
Beech
Pit
BM
Cemetery
Wichita Country Club
Beech Lake
Golf Course
Minneha Sch
Tr Pk
Copeland Landing Strip
Mount Carmel Academy
AVENUE
Beech Factory Landing Field
Trailer Park
Linwood Acres
AVE
Tollgate
EAST WICHITA INTERCHANGE
4 LANE TOLL ROAD
TURNPIKE
KANSAS
Seltzer Sch.
Fox Meadows Country Club
M I N N E H A

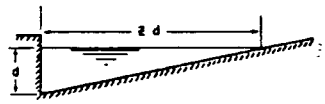
County	Expected 24-hour Storm Rainfall in Inches — Storm Frequency in Years						Normal Annual Precipitation
	100	50	25	10	5	2	Inches
Pawnee	6.6	6.0	5.2	4.5	3.7	2.8	23.3
Phillips	6.0	5.5	4.8	4.1	3.4	2.5	23.6
Pottawatomie	7.5	6.6	5.9	5.1	4.3	3.4	33.6
Pratt	7.2	6.4	5.6	4.8	4.1	3.0	24.6
Rawlins	5.5	5.0	4.3	3.6	3.1	2.3	21.0
Reno	7.4	6.6	5.8	5.0	4.2	3.2	27.7
Republic	6.8	6.0	5.4	4.6	3.9	2.9	28.6
Rice	7.3	6.4	5.6	4.8	4.1	3.0	26.6
Riley	7.4	6.5	5.8	5.1	4.3	3.3	33.5
Rooks	6.1	5.7	4.9	4.1	3.4	2.5	23.9
Rush	6.5	5.9	5.0	4.3	3.6	2.7	23.3
Russell	6.7	5.9	5.2	4.4	3.7	2.8	26.8
Saline	7.3	6.4	5.7	4.9	4.1	3.1	28.4
Scott	5.7	5.3	4.5	3.8	3.2	2.4	20.2
Sedgwick	7.8	7.0	6.1	5.3	4.5	3.5	30.6
Seward	6.0	5.7	4.8	4.2	3.5	2.6	19.8
Shawnee	7.8	6.8	6.1	5.3	4.5	3.5	34.7
Sheridan	5.7	5.3	4.5	3.8	3.2	2.4	21.3
Sherman	5.3	4.8	4.2	3.5	3.0	2.2	16.7
Smith	6.3	5.7	5.0	4.2	3.5	2.6	24.4
Stafford	7.1	6.2	5.5	4.7	4.0	2.9	25.1
Stanton	5.6	5.2	4.5	3.8	3.2	2.4	15.8
Stevens	5.9	5.5	4.7	4.1	3.4	2.5	19.7
Sumner	8.0	7.1	6.2	5.4	4.6	3.6	34.0

x-slope = 3/8"/ft = 0.03125

z = 1/x-slope = 1/0.03125 = 32

n = 0.016

z/n = 32/0.016 = 2000 always



EQUATION: $Q = 0.56\left(\frac{z}{n}\right) S^{\frac{1}{2}} d^{\frac{8}{3}}$

n IS ROUGHNESS COEFFICIENT IN MANNING FORMULA APPROPRIATE TO MATERIAL IN BOTTOM OF CHANNEL

z IS RECIPROCAL OF CROSS SLOPE

REFERENCE: H. R. B. PROCEEDINGS 1946, PAGE 150, EQUATION (14)

EXAMPLE (SEE INSTRUCTION 1)

GIVEN: S = 0.03
z = 24
n = .02
z/n = 1200
Q = 2.0 CFS

FIND: d = 0.22 BY FOLLOWING DASHED LINES

RATIO z/n

10000 9000 8000 7000 6000 5000 4000 3000 2000 1000 900 800 700 600 500 400 300 200 100 90 80 70 60 50 40 30 20 10

TURNING LINE

DISCHARGE (Q) IN CFS

100 70 50 30 20 10 7 5 3 2 1 .7 .5 .3 .2 .1 .07 .05 .03 .02 .01

SLOPE OF CHANNEL (S) IN FT./FT.

.10 .08 .07 .06 .05 .04 .03 .02 .01 .008 .007 .006 .005 .004 .003 .002 .001

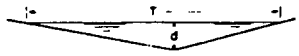
DEPTH AT CURB OR DEEPEST POINT (d) IN FT.

2.0 1.0 .90 .70 .60 .50 .40 .30 .20 .10 .08 .07 .06 .05 .04 .03 .02 .01

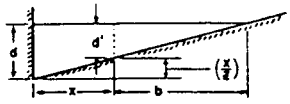
INSTRUCTIONS

1. CONNECT z/n RATIO WITH SLOPE (S) AND CONNECT DISCHARGE (Q) WITH POINT WHERE LINE CROSSES TURNING LINE READ DEPTH AT CURB (d). Q CAN BE FOUND FROM d BY CONNECTING d WITH CROSSING OF TURNING LINE

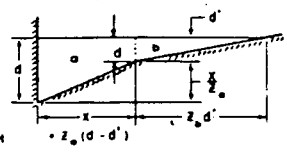
2. FOR SHALLOW V-SHAPED CHANNEL AS SHOWN USE NOMOGRAPH AS EXPLAINED IN INSTRUCTION 1 BUT WITH $z = \frac{T}{d}$.



3. TO DETERMINE DISCHARGE Q_x IN PORTION OF CHANNEL HAVING WIDTH X: DETERMINE DEPTH d FOR TOTAL DISCHARGE IN ENTIRE SECTION AS EXPLAINED IN 1. THEN USE NOMOGRAPH TO DETERMINE Q_b IN SECTION OF WIDTH b FOR DEPTH $d' = d - \left(\frac{x}{z}\right)$. THEN $Q_x = Q - Q_b$.



4. TO DETERMINE DISCHARGE (Q_T) IN COMPOSITE SECTION:- FOLLOW INSTRUCTION 3 TO OBTAIN DISCHARGE (Q_a) IN SECTION a AT ASSUMED DEPTH d BASED ON AN EXTENSION OF SLOPE RATIO z_a TO INTERSECT WATER SURFACE; OBTAIN Q_b FOR SLOPE RATIO z_b AND DEPTH d'; $d' = d - \frac{x}{z_a}$. THEN $Q_T = Q_a + Q_b$.



BUREAU OF PUBLIC ROADS
REV. JAN. 1968

NOMOGRAPH FOR FLOW IN TRIANGULAR CHANNELS

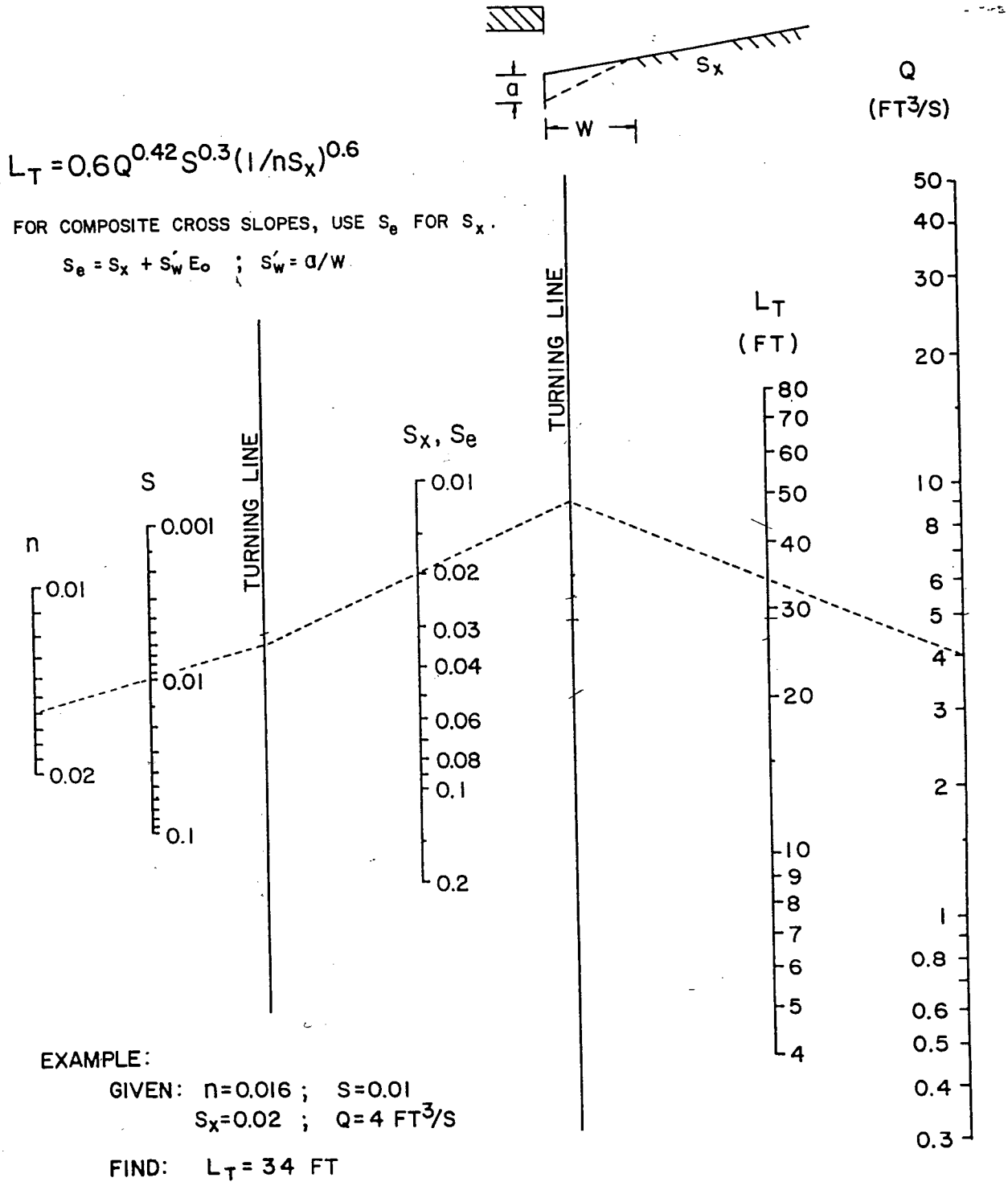


CHART 9. Curb-opening and slotted drain inlet length for total interception.

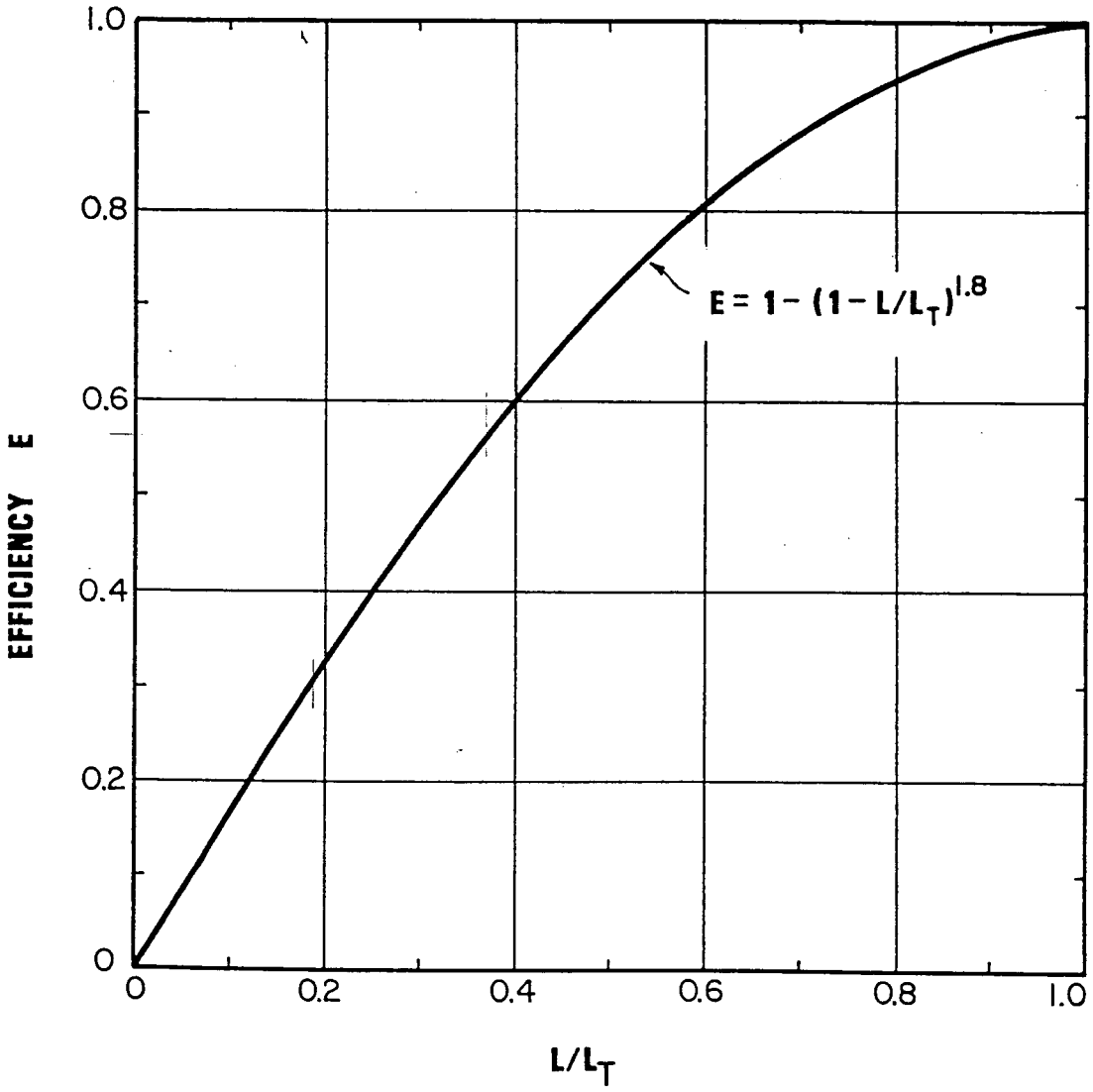


CHART 10. Curb-opening and slotted drain inlet interception efficiency.

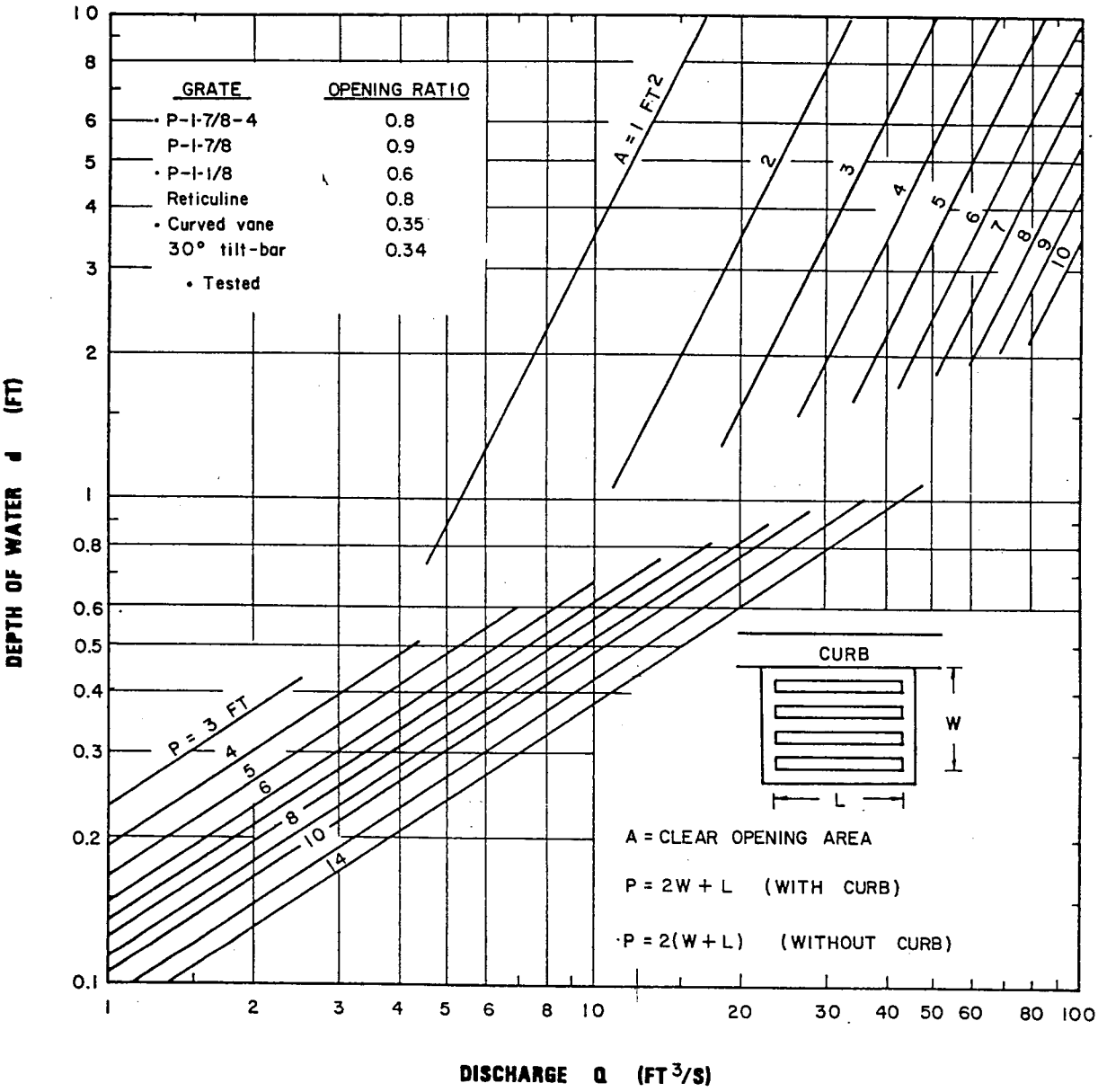


CHART 11. Grate inlet capacity in sump conditions.

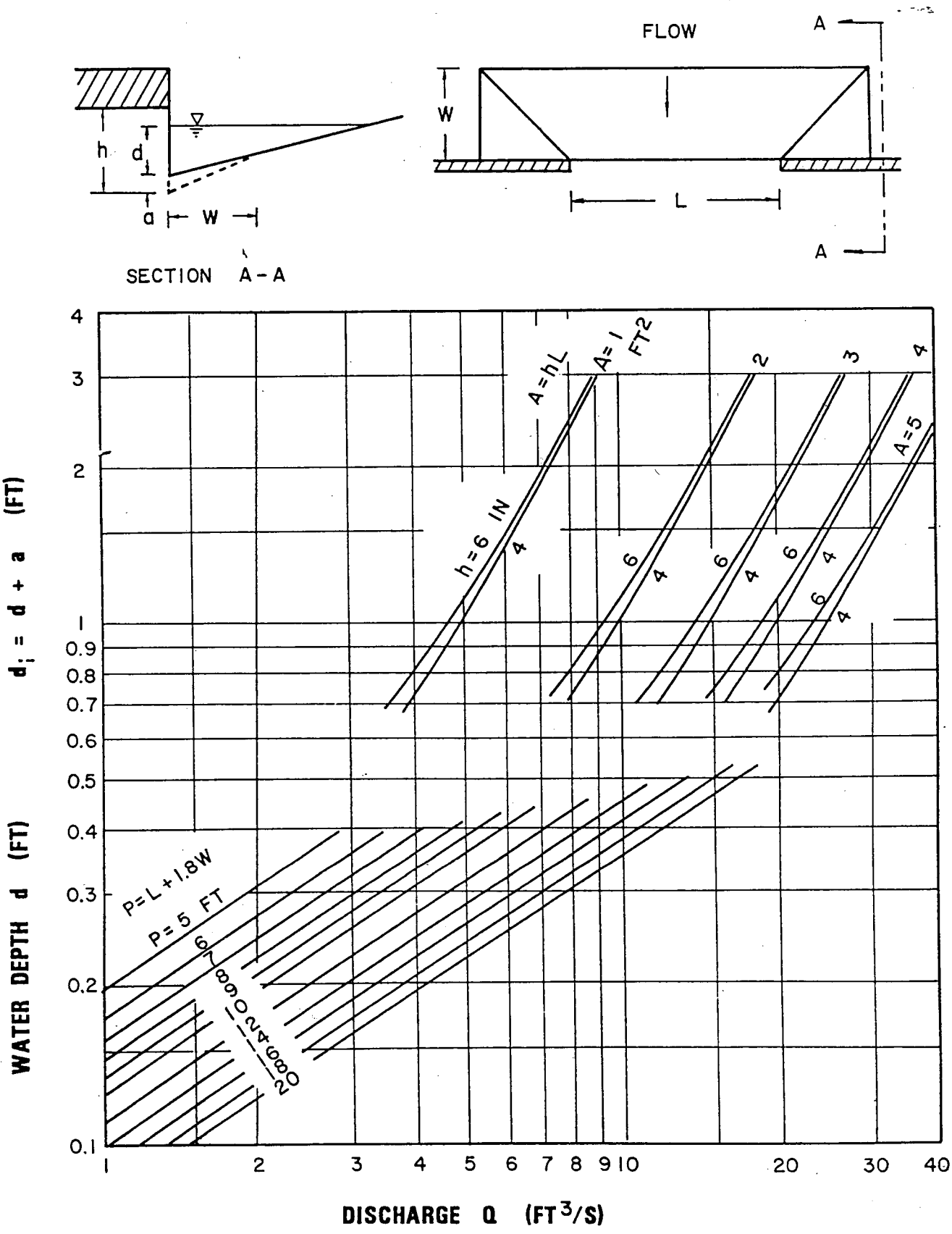


CHART 12. Depressed curb-opening inlet capacity in sump locations.

April 15, 1986

ATTACHMENT A
DRAINAGE CRITERIA MANUAL

RAINFALL INTENSITY TABLE FOR SEDGWICK COUNTY, KANSAS

The following tabulation contains rainfall intensity in inches per hour as derived from ESSA Weather Bureau Technical Paper 40 Modified to NWS Hydro-35, 1977 During First Hour

(T_c) DURATION IN MINUTES	RETURN PERIODS OF 1-YR	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
5	i = 4.18	5.57	6.53	7.41	8.52	9.48	10.32
6	3.99	5.32	6.25	7.09	8.16	9.09	9.89
7	3.81	5.09	5.99	6.81	7.84	8.74	9.50
8	3.66	4.89	5.75	6.55	7.55	8.42	9.15
9	3.52	4.70	5.54	6.31	7.28	8.13	8.83
10	3.39	4.52	5.34	6.09	7.04	7.86	8.54
11	3.27	4.36	5.16	5.89	6.81	7.61	8.27
12	3.18	4.21	4.99	5.71	6.60	7.38	8.02
13	3.05	4.08	4.84	5.53	6.41	7.17	7.79
14	2.96	3.95	4.69	5.37	6.23	6.97	7.57
15	2.87	3.83	4.56	5.22	6.06	6.78	7.37
16	2.78	3.72	4.43	5.08	5.90	6.60	7.18
17	2.71	3.61	4.31	4.95	5.75	6.44	7.00
18	2.63	3.51	4.20	4.83	5.61	6.29	6.84
19	2.56	3.42	4.10	4.71	5.47	6.14	6.68
20	2.50	3.33	4.00	4.60	5.35	6.00	6.53
21	2.44	3.25	3.90	4.50	5.23	5.87	6.39
22	2.38	3.17	3.81	4.40	5.12	5.75	6.26
23	2.32	3.10	3.73	4.31	5.01	5.63	6.13
24	2.27	3.03	3.65	4.22	4.91	5.52	6.01
25	2.22	2.96	3.57	4.13	4.81	5.41	5.90
26	2.20	2.90	3.50	4.05	4.72	5.31	5.79
27	2.16	2.84	3.43	3.98	4.63	5.21	5.69
28	2.14	2.78	3.37	3.90	4.55	5.12	5.59
29	2.11	2.72	3.30	3.83	4.47	5.03	5.49
30	2.08	2.67	3.24	3.76	4.39	4.94	5.40
31	2.05	2.62	3.19	3.70	4.32	4.86	5.32
32	2.02	2.57	3.10	3.63	4.25	4.79	5.22
33	1.99	2.52	3.05	3.57	4.18	4.71	5.14
34	1.96	2.48	3.01	3.51	4.11	4.63	5.07
35	1.93	2.44	2.98	3.46	4.05	4.56	5.00
36	1.91	2.39	2.93	3.41	3.99	4.50	4.93
37	1.89	2.35	2.88	3.36	3.93	4.43	4.86
38	1.87	2.32	2.84	3.31	3.87	4.37	4.79
39	1.85	2.28	2.80	3.26	3.82	4.31	4.73
40	1.83	2.24	2.76	3.22	3.76	4.25	4.66
41	1.81	2.21	2.72	3.17	3.71	4.19	4.60
42	1.79	2.18	2.68	3.13	3.66	4.13	4.54
43	1.77	2.14	2.64	3.09	3.61	4.08	4.49
44	1.75	2.11	2.61	3.05	3.57	4.03	4.43
45	1.73	2.08	2.57	3.01	3.52	3.98	4.38

ATTACHMENT A CONTINUED
Page 2

DURATION IN MINUTES	RETURN PERIODS OF 1-YR	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
46	1.70	2.05	2.54	2.97	3.48	3.93	4.33
47	1.67	2.02	2.50	2.93	3.44	3.88	4.28
48	1.66	2.00	2.47	2.90	3.39	3.84	4.23
49	1.64	1.97	2.44	2.86	3.35	3.79	4.18
50	1.61	1.95	2.41	2.83	3.32	3.75	4.13
51	1.59	1.92	2.38	2.79	3.28	3.71	4.09
52	1.56	1.89	2.35	2.76	3.24	3.67	4.05
53	1.54	1.86	2.33	2.73	3.20	3.63	4.00
54	1.52	1.84	2.30	2.70	3.17	3.59	3.96
55	1.50	1.81	2.27	2.67	3.14	3.55	3.92
56	1.47	1.79	2.25	2.64	3.10	3.51	3.88
57	1.45	1.76	2.22	2.61	3.07	3.48	3.84
58	1.43	1.74	2.20	2.59	3.04	3.44	3.81
59	1.42	1.72	2.18	2.56	3.01	3.41	3.77
60	1.40	1.69	2.15	2.53	2.98	3.37	3.73
61	1.38	1.67	2.13	2.51	2.95	3.34	3.70
62	1.36	1.65	2.11	2.48	2.92	3.31	3.67
63	1.34	1.63	2.09	2.46	2.89	3.28	3.63
64	1.33	1.61	2.07	2.44	2.86	3.25	3.60
65	1.31	1.59	2.05	2.41	2.84	3.22	3.57
66	1.30	1.57	2.03	2.39	2.81	3.19	3.54
67	1.28	1.56	2.01	2.37	2.79	3.16	3.51
68	1.26	1.54	1.99	2.35	2.76	3.13	3.48
69	1.25	1.52	1.97	2.33	2.74	3.10	3.45
70	1.24	1.50	1.95	2.31	2.71	3.08	3.42
71	1.22	1.49	1.93	2.28	2.69	3.05	3.39
72	1.21	1.47	1.92	2.26	2.67	3.02	3.36
73	1.20	1.46	1.90	2.25	2.64	3.00	3.34
74	1.18	1.44	1.88	2.23	2.63	2.98	3.31
75	1.17	1.43	1.86	2.21	2.61	2.95	3.29
76	1.16	1.41	1.85	2.19	2.58	2.93	3.26
77	1.15	1.40	1.83	2.17	2.55	2.90	3.24
78	1.13	1.38	1.82	2.15	2.53	2.88	3.22
79	1.12	1.37	1.80	2.14	2.50	2.86	3.19
80	1.11	1.36	1.79	2.12	2.48	2.84	3.16
81	1.10	1.34	1.77	2.10	2.46	2.82	3.13
82	1.09	1.33	1.76	2.08	2.43	2.79	3.10
83	1.08	1.32	1.74	2.06	2.41	2.76	3.07
84	1.07	1.31	1.73	2.04	2.39	2.74	3.04
85	1.06	1.30	1.72	2.02	2.37	2.71	3.01
86	1.05	1.28	1.70	2.00	2.34	2.69	2.99
87	1.04	1.27	1.69	1.99	2.32	2.66	2.96
88	1.03	1.26	1.68	1.97	2.30	2.64	2.93
89	1.02	1.25	1.68	1.95	2.28	2.62	2.91
90	1.01	1.24	1.66	1.93	2.26	2.59	2.88

DURATION IN MINUTES	RETURN PERIODS OF 1-YR	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
91	1.00	1.23	1.65	1.92	2.24	2.57	2.86
92	1.00	1.22	1.63	1.90	2.22	2.55	2.83
93	0.99	1.21	1.62	1.89	2.20	2.53	2.81
94	0.98	1.20	1.61	1.87	2.19	2.51	2.79
95	0.97	1.19	1.59	1.85	2.17	2.49	2.76
96	0.96	1.18	1.58	1.84	2.15	2.46	2.74
97	0.96	1.17	1.57	1.82	2.13	2.44	2.72
98	0.95	1.16	1.56	1.81	2.12	2.42	2.70
99	0.94	1.15	1.54	1.80	2.10	2.41	2.67
100	0.93	1.14	1.53	1.78	2.08	2.39	2.65
101	0.93	1.13	1.52	1.77	2.07	2.39	2.65
102	0.92	1.13	1.51	1.75	2.05	2.35	2.61
103	0.91	1.12	1.50	1.74	2.04	2.33	2.59
104	0.90	1.11	1.49	1.73	2.02	2.31	2.57
105	0.90	1.10	1.47	1.72	2.01	2.30	2.55
106	0.89	1.09	1.46	1.70	1.99	2.28	2.54
107	0.88	1.09	1.45	1.69	1.98	2.26	2.52
108	0.88	1.08	1.44	1.68	1.96	2.25	2.50
109	0.87	1.07	1.43	1.67	1.95	2.23	2.48
110	0.87	1.06	1.42	1.65	1.93	2.21	2.46
111	0.86	1.06	1.41	1.64	1.92	2.20	2.45
112	0.85	1.05	1.40	1.63	1.91	2.18	2.43
113	0.85	1.04	1.39	1.62	1.89	2.17	2.41
114	0.84	1.03	1.38	1.61	1.88	2.15	2.40
115	0.84	1.03	1.37	1.60	1.87	2.14	2.38
116	0.83	1.02	1.36	1.59	1.86	2.12	2.36
117	0.82	1.01	1.36	1.58	1.84	2.11	2.35
118	0.82	1.01	1.35	1.57	1.83	2.09	2.33
119	0.81	1.00	1.34	1.56	1.82	2.08	2.32
120	0.81	0.99	1.33	1.55	1.81	2.07	2.30

DURATION IN HOURS	RETURN PERIODS OF 1-YR	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
2	0.81	0.99	1.33	1.55	1.81	2.07	2.30
3	0.59	0.72	0.97	1.13	1.32	1.51	1.68
4	0.47	0.58	0.78	0.91	1.06	1.21	1.35
5	0.40	0.49	0.66	0.77	0.89	1.02	1.14
6	0.35	0.42	0.57	0.67	0.78	0.89	0.99
8	0.28	0.34	0.46	0.53	0.62	0.71	0.79
10	0.23	0.29	0.39	0.45	0.52	0.60	0.67
12	0.20	0.25	0.33	0.39	0.45	0.52	0.58
18	0.15	0.18	0.24	0.28	0.33	0.38	0.42
24	0.12	0.15	0.20	0.23	0.27	0.31	0.34

ATTACHMENT B

DRAINAGE CRITERIA MANUAL

INCREMENTAL INFILTRATION VALUES IN INCHES

Time Minutes**	SCS Hydrologic Soil Group			
	A	B	C	D
5	.33	.26	.19	.12
10	.25	.17	.09	.04
15	.18	.11	.05	.02
20	.13	.07	.03	.02
25	.10	.05	.03	.02
30	.08	.05	.03	.02
35	.08	.05	.03	.02
40	.08	.05	.03	.02
45	.08	.05	.03	.02
50	.08	.05	.03	.02
55	.08	.05	.03	.02
60	.08	.05	.03	.02
65	.08	.05	.03	.02
70	.08	.05	.03	.02
75	.08	.05	.03	.02
80	.08	.05	.03	.02
85	.08	.05	.03	.02
90	.08	.05	.03	.02
95	.08	.05	.03	.02
100	.08	.05	.03	.02
105	.08	.05	.03	.02
110	.08	.05	.03	.02
115	.08	.05	.03	.02
120	.08	.05	.03	.02

**Time at end of the time increment

NOTE: Values for 125 minutes and additional 5 minute increments shall be the same as those shown for 120 minutes.

ATTACHMENT C

DRAINAGE CITERIA MANUAL

DEPRESSION STORAGE LOSSES

Surface Type	Total Loss (Inches)
Impervious:	
Paved Areas	0.1
Flat Roofs	0.1
Sloped Roofs	0.05
Pervious:	
Lawns and Grass	0.3
Wooded Areas and Open Fields	0.4

(3 pages)

ATTACHMENT D

DRAINAGE CRITERIA

RECOMMENDED RUNOFF COEFFICIENTS FOR RATIONAL METHOD
AND PERCENT IMPERVIOUS FOR UNIT HYDROGRAPH METHOD

Land Use or Surface Characteristics	Percent Impervious	Frequency 2	5	10	100
1. Business:					
Downtown Areas	95	0.84	0.85	0.87	0.91
Neighborhood Areas	70	0.68	0.69	0.73	0.80
2. Residential:					
Single Family (Soil Group D)					
1/8 Acre	50	0.57	0.61	0.66	0.79
1/4 Acre	38	0.50	0.54	0.62	0.76
1/3 Acre	30	0.46	0.50	0.59	0.73
1/2 Acre	25	0.42	0.48	0.56	0.72
3/4 Acre	22	0.42	0.46	0.55	0.71
1 Acre	20	0.41	0.45	0.54	0.71
Multi-Family (Soil Group D)					
Multi-Unit (detached)	60	0.62	0.66	0.72	0.82
Multi-Unit (attached)	65	0.64	0.68	0.73	0.83
Apartments	75	0.70	0.73	0.79	0.86
Single Family (Soil Group C)					
1/8 Acre	50	0.55	0.58	0.64	0.73
1/4 Acre	38	0.48	0.51	0.57	0.68
1/3 Acre	30	0.43	0.46	0.53	0.65
1/2 Acre	25	0.40	0.43	0.50	0.63
3/4 Acre	22	0.39	0.42	0.49	0.62
1 Acre	20	0.37	0.40	0.48	0.61
Multi-Family (Soil Group C)					
Multi-Unit (detached)	60	0.60	0.63	0.69	0.77
Multi-Unit (attached)	65	0.63	0.66	0.71	0.79
Apartments	75	0.68	0.72	0.77	0.83
Single-Family (Soil Group B)					
1/8 Acre	50	0.52	0.54	0.59	0.67
1/4 Acre	38	0.44	0.46	0.52	0.61
1/3 Acre	30	0.39	0.41	0.47	0.57
1/2 Acre	25	0.36	0.38	0.44	0.54
3/4 Acre	22	0.34	0.36	0.42	0.52
1 Acre	20	0.33	0.35	0.40	0.51
Multi-Family (Soil Group B)					
Multi-Unit (detached)	60	0.58	0.60	0.65	0.72
Multi-Unit (attached)	65	0.61	0.64	0.68	0.75
Apartments	75	0.67	0.70	0.74	0.80

Land Use or rface Characteristics	Percent Impervious	Frequency 2	5	10	100
Single Family (Soil Group A)					
1/8 Acre	50	0.47	0.50	0.54	0.60
1/4 Acre	38	0.39	0.41	0.45	0.52
1/3 Acre	30	0.33	0.35	0.39	0.47
1/2 Acre	25	0.30	0.31	0.35	0.44
3/4 Acre	22	0.28	0.29	0.33	0.42
1 Acre	20	0.26	0.28	0.32	0.40
Multi-Family (Soil Group A)					
Multi-Unit (detached)	60	0.55	0.57	0.61	0.67
Multi-Unit (attached)	65	0.58	0.60	0.64	0.70
Apartments	75	0.65	0.68	0.72	0.77
3. Industrial:					
Light Areas	70	0.68	0.69	0.73	0.80
Heavy Areas	80	0.74	0.76	0.79	0.84
4. Playgrounds:	15	0.33	0.35	0.42	0.55
5. Schools:	40	0.49	0.51	0.56	0.66
6. Railroad Yard Areas:	30	0.43	0.45	0.50	0.62
Undeveloped Urban Areas:					
Offsite Flow Analysis (when land use not defined)	45	0.52	0.54	0.59	0.68
8. Streets:					
Paved	99	0.87	0.88	0.90	0.93
Gravel	00	0.24	0.26	0.33	0.48
9. Drive, Parking Lots and Walks:	96	0.87	0.87	0.88	0.89
10. Roofs:	90	0.80	0.85	0.90	0.93
11. Urban Lawn Areas (See Note No. 1 below):					
Soil Group A					
Slope less than 1%	00	0.08	0.09	0.13	0.23
Slope 1% to 4%	00	0.12	0.13	0.17	0.27
Slope more than 4%	00	0.16	0.17	0.21	0.31
Soil Group B					
Slope less than 1%	00	0.16	0.18	0.24	0.37
Slope 1% to 4%	00	0.20	0.22	0.28	0.41
Slope more than 4%	00	0.24	0.26	0.32	0.45
Soil Group C					
Slope less than 1%	00	0.24	0.27	0.35	0.51
Slope 1% to 4%	00	0.26	0.29	0.37	0.53
Slope more than 4%	00	0.28	0.31	0.39	0.55

Land Use or rface Characteristics	Percent Impervious	Frequency 2	5	10	100
Soil Group D					
Slope less than 1%	00	0.28	0.33	0.43	0.63
Slope 1% to 4%	00	0.30	0.35	0.45	0.65
Slope more than 4%	00	0.32	0.37	0.47	0.67

Note No. 1: Coefficients shown in the above table are for pervious open space areas with thick turf which includes pervious areas in parks and cemeteries. Coefficients shown above must be increased 0.02 for use with agricultural pasture areas. Coefficients shown above must be reduced by 0.04 for use with agricultural cultivated areas. Group A soils are well-drained, coarse textured sands with high infiltration rates. Group B soils are moderately well-drained, moderately coarse textured soils with moderate infiltration rates. Group C soils are moderately poor-drained, moderately fine textured soils with slow infiltration rates. Group D soils are poor-drained, fine textured soils with very slow infiltration rates.

GENERAL NOTE: These Rational Formula Coefficients may not be valid for basins 320 acres or larger.

ATTACHMENT E

DRAINAGE CRITERIA

AVERAGE OVERLAND FLOW VELOCITY FOR USE WITH URBANIZED AREAS

Surface Type	VELOCITY IN FEET/SECOND FOR SLOPES IN PERCENT SHOWN																			
	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	20.0
Forest with Heavy Ground Litter or Meadow	0.03	0.04	0.06	0.07	0.08	0.09	0.10	0.11	0.12	0.13	0.16	0.21	0.28	0.33	0.39	0.46	0.53	0.60	0.72	1.10
Fallow or Minimum Tillage Cultivation	0.06	0.08	0.10	0.12	0.13	0.14	0.16	0.17	0.18	0.19	0.29	0.40	0.51	0.66	0.78	0.91	1.05	1.20	1.44	2.10
Short Grass Pasture or Lawns	0.09	0.13	0.15	0.18	0.20	0.21	0.23	0.25	0.26	0.28	0.45	0.60	0.77	0.96	1.17	1.33	1.50	1.68	1.98	3.20
Almost Bare Ground	0.16	0.22	0.28	0.31	0.35	0.38	0.41	0.44	0.46	0.49	0.70	0.85	1.05	1.26	1.50	1.75	2.03	2.32	2.79	4.40
Grassed Waterway	0.35	0.48	0.58	0.67	0.77	0.84	0.91	0.98	1.05	1.12	1.54	1.82	2.10	2.38	2.78	3.20	3.66	4.14	4.56	7.00
Paved Areas (Sheet Flow) or Shallow Gutter Flow	0.44	0.62	0.77	0.91	1.05	1.12	1.19	1.26	1.33	1.40	2.00	2.55	3.20	3.83	4.41	5.04	5.70	6.00	6.20	9.00

ATTACHMENT F

DETERMINATION OF DIMENSIONLESS WATERSHED CONVEYANCE FACTOR (Ø)

$$\emptyset = \emptyset_1 + \emptyset_2$$

$\emptyset_1$	Classification
0.6	Extensive channel improvement and storm sewer system, closed conduit channel system
0.7	Moderate channel improvement and storm sewer system.
0.8	Some channel improvement and storm sewers, mainly cleaning and enlargement of existing channel.
0.9	Little channel improvement and storm sewers.
1.0	Natural channel conditions.

$\emptyset_2$	Classification
0.0	No channel vegetation.
0.1	Light channel vegetation.
0.2	Moderate channel vegetation.
0.3	Heavy channel vegetation.

EXHIBIT NO. 1

SOIL LEGEND

SYMBOL	HYDROLOGIC GROUP	NAME
Aa	B	Albion-Shellabarger sandy loams, 1 to 4 percent slopes
Ab	B	Albion and Shellabarger sandy loans, 7 to 15 percent slopes
Ba	C	Blanket silt loam, 0 to 1 percent slopes
Bb	C	Blanket silt loan, 1 to 3 percent slopes
Ca	B	Canadian fine sandy loan
Cb	B	Canadian-Waldeck fine sandy loams
Cc	D	Carwile fine sandy loam
Cd	B	Clark-Ost clay loams, 1 to 4 percent slopes
Ce	C	Clime silty clay, 3 to 6 percent slopes
Ea	B	Elandco silt loam
Eb	B	Elandco silt loam, occasionally flooded
Ec	B	Elandco silt loam, frequently flooded
Fa	B	Farnum loam, 0 to 1 percent slopes
Fb	B	Farnum loam, 1 to 3 percent slopes
Fc	B	Farnum loam, sandy substratum, 0 to 1 percent slopes
Ga	D	Goessel silty clay, 0 to 1 percent slopes
Gb	D	Goessel silty clay, 1 to 2 percent slopes
Ia	D	Irwin silty clay loam, 1 to 3 percent slopes
Ib	D	Irwin silty clay loam, 3 to 6 percent slopes
Ic	D	Irwin silty clay loam, 2 to 6 percent slopes, eroded
La	C	Lesho loam
Lb	A	Lincoln soils
Ma	B	Milan loam, 1 to 3 percent slopes
Mb	B	Milan form, 3 to 6 percent slopes
Mc	B	Milan clay loam, 2 to 6 percent slopes, eroded
Na	B	Naron fine sandy loam
Oc	D	Owens clay loam, 1 to 3 percent slopes
Od	D	Owens-Rock outcrop complex, 3 to 10 percent slopes
Pa		Pits
Pb	D	Plevna fine sandy loam
Pc	A	Pratt loamy fine sand, undulating
Pd	A	Pratt-Tivoli complex, rolling
Ra	D	Renfrow silty clay loam, 1 to 3 percent slopes
Rb	D	Renfrow silty clay loam, 3 to 6 percent slopes
Rc	D	Renfrow-Owens clay loams, 1 to 4 percent slopes
Rd	D	Rosehill silty clay, 1 to 3 percent slopes
Sa	B	Shellabarger sandy loam, 1 to 3 percent slopes
Sb	B	Shellabarger sandy loam, 3 to 6 percent slopes
Sc	B	Shellabarger sandy loam, 3 to 6 percent slopes, eroded
Ta	D	Tabler silty clay loam
Tb	D	Tabler-Drummond complex
Ua	B	Urban land-Canadian complex
Ub	B	Urban land-Elandco complex
Uc	B	Urban land-Farnum complex, 0 to 3 percent slopes
Ud	D	Urban land-Irwin complex, 1 to 3 percent slopes
Ue	D	Urban land-Tabler complex
Va	B	Vanoss silt loam, 0 to 1 percent slopes
Vb	B	Vanoss silt loam, 1 to 3 percent slopes
Vc	B	Vanoss silt loam, 3 to 6 percent slopes
Vd	B	Vanoss silt loam, 3 to 6 percent slopes, eroded
Ve	D	Vernon sandy loam, 1 to 3 percent slopes
Vf	D	Vernon sandy loam, 3 to 6 percent lopes
Wa	C	Waldeck sandy loam
Wb	D	Waumika silt loam